Bone Tool Technology on Easter Island

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One of the attractions of Easter Island is the grand display of a complex technology embodied in the archaeological record—the *ahu* and associated statuary. Yet it is the smaller, less spectacular elements in other technological industries which provide the greatest insights into that prehistoric culture—into the industrial repertoire of one of the most isolated and environmentally impoverished islands in the south Pacific: into the ability of the prehistoric islander to adapt and make use of this environment; and into everyday routine (perhaps even mundane) activities of life on this small island. In particular, it is those elements of the material culture inventory which were either in production or use on a nearly daily basis and which display the indelible mark of the craftsman in form and across the surfaces--namely hand tools; those implements made either form stone or bone. Of the two, stone tools have at least been the subject of a few papers and articles discussing such topics as quarrying activity in the obsidian deposits; morphology, classification and analysis of expedient tools made from waste flakes; *mata'a* and even the chisels littering the statue quarry (see for example Beardsley et al. 1991; Ferdon 1961; Stevenson et al 1984; Ayres and Spear n.d.; Cheatham and Ayres n.d.). Bone tools and implements, on the other hand, have received virtually no attention; they have often been relegated to a brief note in a list of artifacts present at a given site (Ayres 1975; Ferdon 1961; Stevenson 1988).

The next few pages present an outline of the results of one of the few investigations into the bone tool industry of prehistoric Easter Island. The collection that has become the basis for the following observations on the prehistoric era bone industry is housed at the University of Oregon and consists almost exclusively of bone debitage, that artifactual residue of reduction, manufacture, modification, and use. It is actually a portion of a larger collection recovered by William Ayres (1975) during his work on the island some 20 years ago; the rest of the collection has remained on the island. In addition, the experimental replication work conducted in an effort to reproduce the manufacturing marks and technological processes involved in the production activities observed in the collection will be summarized

In developing a picture of any technological industry within a prehistoric era culture, the use of debitage is of the utmost importance because the history of the manufacturing process is retained in the residual marks across the artifact surfaces. As production of bone implements or other articles is a subtractive process, the by-products or waste (i.e., debitage) will tend to be deposited at or near the place of origin or manufacture; whereas a formal implement will more often be deposited at the last of what is likely a long line of use locations (this naturally has implications for interpreting the activities conducted at a specific site as well as the post-depositional factors affecting a site and its cultural deposit, but that is another topic best reserved for a later article). A correlate to the deposition of production by-products is that the sequence of reduction, modification, and hence manufacture of a variety of bone implements can be easily traced and clarified, and the methods and devices used in that process at least inferred. As Semenov (1964) points out, it is only through the repated observations of similar patterns of modification on several items of like nature that the fundamental features of a reduction process, implement function, or use are ultimately derived. Unfortunately, one factor which has affected the final outcome of the present study is the lack of formal or at least complete implements in the analysis collection; this discrepancy has injected a degree of ambiguity into the discussion as the full range of end-products remains unknown.

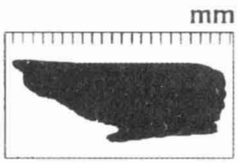
The analysis collection consists of 169 artifacts of chicken (possibly other bird), mammal (which could also include human skeletal material), fish, ray, shark, and unidentified bone; there might also be some rat bone in the collection as it appears in the midden. The artifact types include needle fragments (needles are the most prevalent of all formed bone artifacts), a fishhook shank, drilled vertebrae, possible awls, a potential tattooing comb fragment, shark tooth scrapers, debitage (by far the largest group of artifacts), and expedient ad hoc tools made from the odd fragments of bone debris. It should be noted here that type designations are based on inferred function and are always open to change as more information becomes available. All artifacts were recovered from surface and subsurface contexts in 14 coastal and inland caves from all around the island, and one *hare paenga* in Anakena (Ayres 1975). Within the chronological sequence for the island, the sites and hence artifact assemblages date from the Expansion (Ahu Moai; Middle Period) Phase into at least the Protohistoric (Late Period) Phase.

Examination of the artifacts involved measuring and describing each, with particular attention paid to any stray marks or traces of manufacture, modification and use. It proceeded on the premise of what Jacob Bronowski, the British mathematician, calls the double power of the artifact--that is, an invention which carries its own blueprint with it, allowing us to see forward into its use and backward into its manufacture (Bronowski 1978:65). Magnification was used to examine many of the manufacturing and/or wear marks, and it served two purposes: the first is to determine the general pattern of micro-relief or micro-structure common to particular bone types so that anomalous striations or irregularities across the bone surface could more easily be detected; the second is to determine the pattern of preservation across the surfaces of a given artifact, and hence the degree of clarity that might be expected in the traces of wear and/or modification. On a severely weathered item, for example, the modificatons may be all but erased; whereas a highly preserved item may retain virtually the entire history of its modification. Needless to say, these are the extremes—the artifacts in the UO collection lay somewhere in between the two.

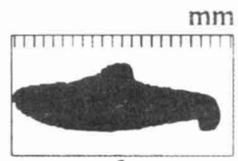
The artifacts

The various artifact types included in the analysis collection are described below, beginning with the largest group of formed artifacts-needles; actually needle fragments, as there are no complete needles within the collection.

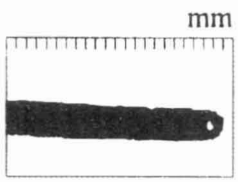
The needle fragments are divided into four groups: shaft fragments, shafts with tips, shafts with butts, and shafts with eyes. All needles are chicken bone, with at least one from a femur, several from tibia, and still many more from unidentifiable long bones. The fragments represent the full range of production stages from needle blanks in the initial stages of formation to completed needles, discarded after a long use-life. In the initial production stages, the needle blank has a rough surface with many bone fiber snags. The surface is covered with fine and coarse grained striations that were generated by the grinding work in the initial surface preparation just prior to splitting the long bone (raw material) as well as grinding from the shaping work applied in creating the blank. Stray cut marks also appear on the needle blank surface—these are from that first steps of splitting the bone and forming the blank. As production proceeded, according to the evidence within the collection, the needle tip was shaped solely by grinding the lateral edges, the interior of the bone surface, and the outer or exterior bone surface. The butt end of the needle required somewhat more preparation. It was first blunted or sawed flat, then shaped by grinding. The grinding work is visible on the interior side of the bone and on the lateral edges; it serves to both round out and thin the butt. Next, the overall outline of the needle blank was completed, again by grinding. Finally, the eye was formed by drilling from one face of the needle to the other. For the most part, the eye is cylindrical but it can also appear irregular in shape. Drilling is unidirectional with the point of entry represented by a rounded, beveled edge and the point of exit characterized by a sharp angled edge, sometimes with flaking scars present from the pressures caused by the exiting drill bit (Stevenson, personal communication, has recovered bone needles in which the eye displays evidence of drilling from both faces of the needle).



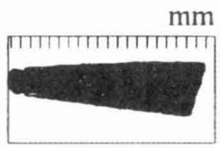
1
Serrated debris
7-1-942



2
Fishhook shank
7-1-931



3
Needle fragment
12-1-111



4
Tattoo comb fragment
8-168-203

Bone Artifacts from the Easter Island collection, University of Oregon

With use, the needle acquired a surface polish that gradually smoothed and erased all manufacturing marks. On the interior side of the bone, which is concave, the projecting surfaces were the first to be polished; but over time and with use, nearly the entire concavity became smoothed and polished. The tip became blunted or rounded, and sometimes discolored; the butt simply acquired a polish. As for the eye, its shape is slightly modified by the addition of what can only be thread wear—a groove or channel or linear depression that formed along the direction the thread was most often pulled, usually parallel to the long axis of the needle.

One artifact, tentatively identified as the fragment of a tattooing comb, also displays wear from a fibrous cord or thread, but in this instance the pattern of linear depressions is consistent with haft wear rather than thread wear. This fragment is made from what appears to be a chicken metatarsal and has a head or knob set apart from the working end by V-shaped notches cut into the lateral edges. The haft wear consists of linear depressions transverse to the main axis of the implement and appears on the knob, in the notches, and just below the notches. The whole item has been shaped by grinding.

Other artifacts in the collection include a fishhook shank, which is made from a more substantial bone than a chicken bone; it has been identified as mammal, and was most likely human. The fragment has been subjected to extensive grinding to shape the surface, rounding it out and thinning it in places (like the head); some cutting or sawing to form the initial shape of the head; and some drilling and filing to create the inner side of the bend and the internal barb (of which only a stub remains). There are also drilled vertebrae (fish and ray) which display the same unidirectional drilling as the needle eyes, and there are shark teeth with wear that ranges from a few flakes of enamel removed from the tip to heavily damaged edges suggestive of scraping activity. The wear marks in the latter instance also include striations that cross the surface of the tooth from one edge to the other.

Awls are another category of artifact within the collection; although this identification is somewhat more tentative given the condition of the bones. Two of the bones appear to be fish. They are heavily exfoliated or weathered and have dulled, rounded tips. No manufacturing marks or use wear are visible. A third is of an unidentifiable bone with a broken tip and wear marks that consist of striations parallel to the long axis of the bone. The bone is an entire diaphysis, although without the knobs or epiphyseal ends. The last artifact category is debitage, the largest group of artifacts. It contains some of the most informative elements within the prehistoric bone industry on the island because of the remnant marks of manufacture present on much of the debris. These manufacture marks reveal not only the sequence of reduction, but also the techniques used. Whether the bone is chicken or mammal (including human), the sequence of reduction is essentially the same: the epiphyseal ends were removed, then the shaft was split. Removal of the knob ends involved primarily sawing at least partially through the bone, after which the knobs were broken or snapped off. The bone shaft was then prepared for splitting—the surface was roughened by grinding, with the movement running parallel to the long axis, then a series of cuts were made, one atop the other, in an effort to establish a groove which in turn would serve as the point of severance. Long sawing cuts were then used to complete the groove; like the cuts severing the epiphyseal ends, the groove was sawed only partially through the bone wall, then broken (by a wedge, a hammer, a chisel and hammer, twisting, or any other method or device that is both expeditious and effective). If the break strayed from the groove, usually this happened at one end or the other, it most often resulted in a spiral fracture, a common fracture type in green bone. Sometimes, too, static loading fractures were created along the edge of the cut, particularly on chicken bone (a product of the method of breakage?). From this point, selected shaft fragments were further worked into the desired end product—whether that was a needle, fishhook, or some other item.

Within the debitage category itself, there were a few worked flakes or splinters shaped into what can only be described as amorphous items, intended possibly as expedient tools. Among the mammal bone fragments, this included a few fragments that had been ground to a point; on these items, all surfaces were ground. One example of unusual workmanship was observed on a chicken bone fragments serrated, saw-tooth edge with fairly regular teeth cut across the width of the fragment. The purpose for which such an edge was intended remains unknown, but it does at least provide some insight into the amount of skill and control exerted over the modification and manipulation of bone as a raw material.

The experiments

The experimental replication work was intended to reproduce as much as possible the patterns of the manufacturing marks observed in the bone debitage, and to at least narrow the range of potential devices used in the reduction work. As the majority of debitage was the result of needle production and other items made of chicken bone, the experiments were focused on the reduction of gallinaceous bones. Scoria (vesicular basalt) and obsidian were used to shape and alter the bone. Both rock types are commonly found on Easter Island, and as they are both local and easily accessible they were considered the more likely choices for expedient tool material. Certainly other materials could have been used to fashion the bone-the whole range of basalts including vesicular basalt, pumice, and even a finer grained basalt, obsidian, coral, sea urchin spines, and any other material useful in abrading and cutting activities—this aspect of the manufacturing process is not in dispute. What is in question is that processing and of itself—what were the steps of manufacture in the production of bone implements? By using just the scoria and obsidian nearly all the production marks in the collection were replicated—the saw marks used to remove the epiphyseal ends of the bone; the abrasion marks that characterized the surface preparation of the bone shaft as well as the shaping work on, for example, a needle blank; the stray cuts made while establishing the principal cut to separate the bone (these stray cuts also don the surfaces of needle blanks); and the cutting/separation groove itself.

One feature which could not be satisfactorily replicated was the needle eye. What is known is that the eye was drilled—some unidirectional, others bi-directional—but the device used as the drill bit remains obscure. Whatever it may be, it had to have a diameter of less than about 2 mm in order to produce a needle eye with a diameter between about 1 and 2 mm. This observation on the basic form of the drill bit is founded solely on the fundamental premise that a hole created by drilling will always be larger than the drill bit used. Also, the expected wear on the drill bit itself should generally run transverse to the main axis of the bit, around its circumference. Obsidian is out of the question for this purpose owing to the diameter of the bit needed for the drilling and the fact that obsidian simply does not hold an edge—the edges are friable and tend to dull quickly by fracturing and splintering when in contact with relatively hard material. It should be noted that there are obsidian drills reported in archaeological assemblages from the island (Ayres and Spear n.d.); however, they are all of a size much too large for needle eyes. Just how were the needle eyes made? This is one of the more intriguing small mysteries of the island.

Summary

So what does all this say about the bone industry of the prehistoric era? First it demonstrates that bone was a viable alternative material from which a variety of utilitarian implements were fashioned—needles, fishhooks, awls, and other miscellaneous items—as well as ornamental items such as pendants reported from other collections. Its durability, elasticity, availability, and malleability make it a unique and valuable raw material, so it is not surprising that bone was the focus of one of the technological systems on the island, especially when so few choices of raw materials were available.

Second, no specialized tool kit was needed to work the bone; rather, a wide variety of unmodified or slightly modified local materials could be used in an opportunistic and expedient manner to reduce and shape the bone. The process of modification—from the initial fragmentation of a selected bone to the final finishing touches of a specific end product—has left its history in the residual patterns of reduction marks and use wear. Experimental replication studies reproduced these manufacturing marks which included grinding, filing, sawing, scraping, incising, and even drilling. Unfortunately, the device(s) used to fashion the drilled needle eye remains to be identified.

Finally, the differential preservation of bone has hampered extensive examinations of this material industry (at least relative to the lithic industry), and perhaps has influenced the frequency, or lack thereof, with which bone artifacts are reported in the archaeological literature. Yet the mere presence of such an industry in the overall archaeological assemblage only serves to enrich the fabric of the prehistoric tapestry of life on this island. The next step is to extend the work here to other collections from the island and expand and correct as needed the preliminary description presented here; establish a time depth for this industry, especially as the current analysis collection came from relatively late contexts; and finally begin comparing the bone industry on Easter Island with that found on other Pacific islands in Polynesia and in the other regions of the Pacific.

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